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Technology Opportunity

Technology Transfer & Partnership Office

TOP3–00154

Microgravity Emissions Laboratory (MEL)

Technology

The NASA Glenn Research Center's (GRC) Microgravity Emissions Laboratory (MEL) utilizes a low-frequency acceleration measurement system for the characterization of rigid body inertial forces generated by various operating components of the International Space Station (ISS).

Benefits

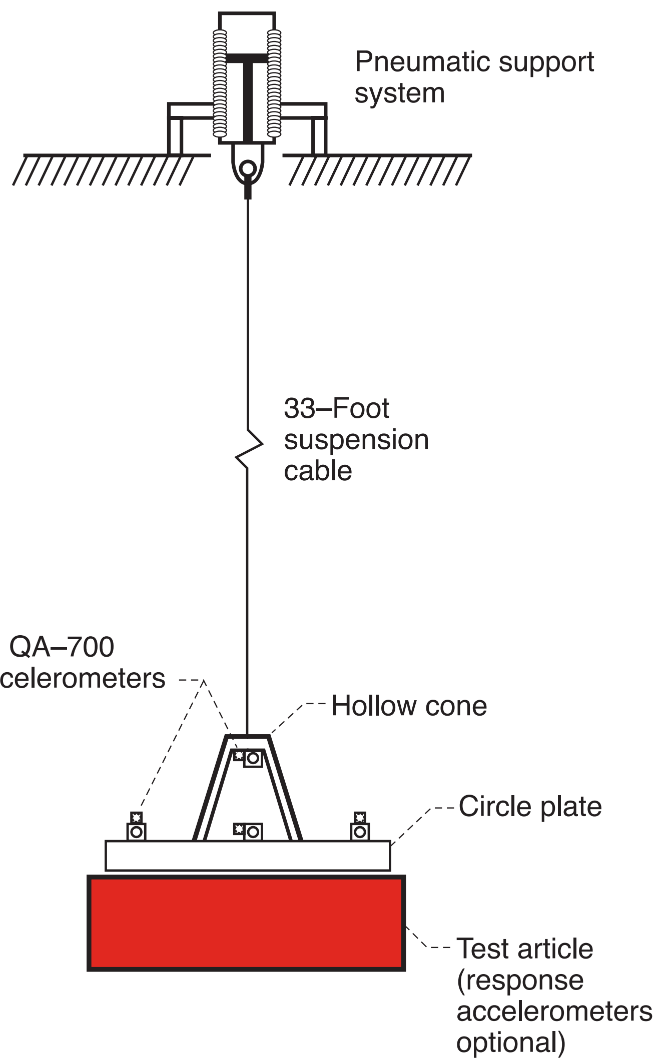
The MEL facility gives customers a test-verified way of measuring their compliance to ISS requirements for vibratory disturbances levels. The facility is unique in that 6-degrees-of-freedom inertial forces can simultaneously be characterized for an operating test article down to 0.10 μg. Vibratory disturbance levels can be measured for engineering or flight-level hardware following development from component to subassembly through the rack-level configuration. Payload developers in need of additional structural dynamic vibration testing will meet all of their testing needs in one facility at NASA GRC.

Commercial Applications

The laboratory can be used to obtain mass properties of complex hardware with uneven mass distribution that cannot be readily calculated. The mass moment of inertia of assemblies is measured in all three axes for every MEL test. Steady state and transient event force and moment data are calculated from the measured accelerations and can be directly input to finite element modeling (FEM), statistical energy analysis (SEA), and other analysis programs. Using accelerometers on the test article, MEL can measure operational responses for various microgravity and aerospace applications.

Technology Description

The MEL was developed for the support, simulation, and verification of the ISS microgravity environment. The acceleration emissions generated by various operating components of ISS, if too large, could hinder the science performed on ISS by disturbing the microgravity environment. Typical test components include operating disk drives, pumps, motors, solenoids, fans, and cameras. Other MEL test articles have included spacecraft onboard electric power systems, optical

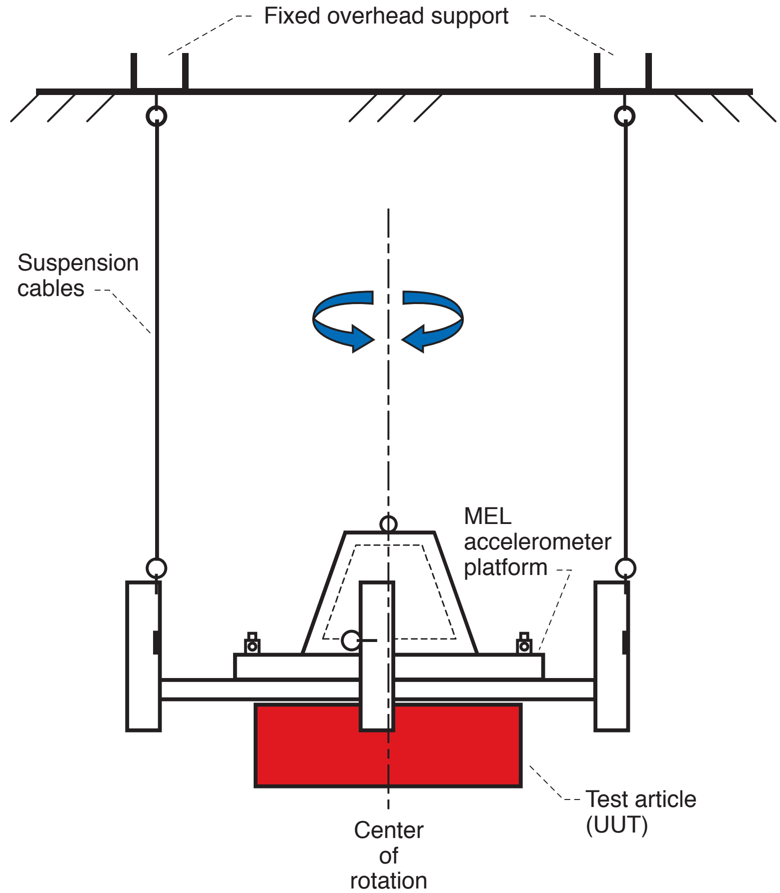


Microgravity Emissions Laboratory mechanical setup.

measurement systems, and crystal growth experiment assemblies. Electrical or fluid-driven support systems that operate the hardware are customer supplied. The MEL is a low-frequency (0.15 to 0.65 Hz) isolator that is a pendulous-based system. The isolation system suspends the measurement apparatus with the attached test unit by a long cable. The lateral frequencies are established with the pendulum and the vertical mode is lowered by the isolation system mechanism. The mechanism reduces the system's vertical frequencies to approximately 0.2 Hz by bearing the weight of the payload through a semipassive frictionless air spring.

The MEL approach is to measure the component's generated inertial forces. This force is a product of the full diagonal mass matrix including the test setup (the center of gravity, mass moment of inertia, and weight) and the resolved rigid body acceleration vector derived from the 10 MEL QA–700 servo control accelerometers. The measured motion of the rigid body is characterized through the MEL test and post processing of the accelerometer data is done to calculate the rigid body component forces and moments at the center of gravity or interface science region location of interest for the test unit. The mass moment of inertia is measured using the bifilar torsional pendulum method. Many output data formats are processed and stored for each test including time history domain force and moment data, as well as frequency domain force and moment power spectral density (PSD), linear spectrum in narrowband or one-third octave band representations.

Vertical mounting space for testing is 3 by 3.5 by 7 ft. Typical component assemblies can be mounted 2 by 2 by 2 ft. The suspension systems can each withstand 600, 750, or 1200 lb., and can be used in parallel to accommodate larger ISS rack weight applications.



Mass-moment-of-inertia determination using bifilar pendulum method.

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Key Words

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References

http://facilities.grc.nasa.gov/mel

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